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Description

Dual Radius Twist Lock Radome And Reflector Antenna for Radome

BACKGROUND OF INVENTION

[0001] Field of the Invention

[0002] This invention relates to radomes and more particularly to a radome and reflector antenna pair having ease of installation and improved reflection / transmission characteristics.

[0003] Description of Related Art

[0004] Reflector antennas are used in, for example, communications systems. Radomes are used to cover the open end of the reflector to minimize wind loading and antenna performance degradation due to environmental fouling of the antenna reflector and or feed assembly.

[0005] Reflector antennas are subject to expansion and contraction due to temperature change. The reflector and the radome are formed from different materials, typically hav-

ing different expansion coefficients. The interconnection between the radome and the reflector should accommodate differential expansion between the radome material and the reflector material, without compromising the mechanical attachment integrity or environmental seal between the radome and the reflector. Also, the interconnection should not create a stress that may deform the precision surfaces of the reflector and degrade the overall antenna reception sensitivity and or radiation patterns.

[0006] Prior radomes utilize a dielectric fabric, fiberglass or a molded dielectric plastic cover attached with a plurality of spring and or screw connections around the periphery of the reflector or a reflector shroud. The associated plurality of springs, clips, screws, and or brackets are a significant burden during installation and or service of the reflector antenna high upon radio towers or other difficult to access locations.

[0007] The radome also creates an impedance discontinuity within the RF signal path that generates a return loss due to RF reflections off of the radome directly or via further reflections back into the antenna feed. United Kingdom Patent Application No. 2120858 by Young, et al. published December 7, 1983 discloses that a reflector an-

tenna radome may be formed with concentric outer and inner parabioloidal portions so that a significant portion of reflected RF energy that may otherwise be aligned to reflect back into the antenna feed is instead directed by the inner parabioloidal portion to the backside of the feed assembly sub reflector where RF absorbing material may be located. However, the significantly reduced focal length of the inner parabioloidal portion necessary to direct the RF energy to the back of the sub reflector causes the radome to have a significant center protrusion and associated additional structural mass, negatively affecting the windload and or other structural requirements of the radome, reflector antenna and support structure. Also, the center protrusion provides a surface for snow and or ice build up.

[0008] Competition within the reflector antenna industry has focused attention on RF performance, structural integrity, materials and manufacturing operations costs. Also, ease of installation and service is a growing consideration in the reflector antenna market.

[0009] Therefore, it is an object of the invention to provide an apparatus that overcomes deficiencies in the prior art.

BRIEF DESCRIPTION OF DRAWINGS

[0010] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

[0011] Figure 1a is an isometric view of one embodiment of a radome according to one embodiment of the invention, showing the front surface and side edge.

[0012] Figure 1b is a cross-section side view of figure 1.

[0013] Figure 2 is a cross-section side view of a reflector antenna with a radome according to one embodiment of the invention.

[0014] Figure 3 is a side schematic view of a reflector antenna section, structure removed for clarity, showing ray traces of reflections from the radome of figures 1 and 2.

[0015] Figure 4 is an isometric close-up view of the back surface outer edge of the radome of figures 1 and 2.

[0016] Figure 5 is an isometric back view of the radome of figures 1 and 2 aligned for connection with a reflector.

[0017] Figure 6 is an isometric back view of the radome and reflector of figure 5 keyed together prior to locking.

[0018] Figure 7 is an isometric back view of the radome and re-

flector of figure 5 locked together.

[0019] Figure 8 is an isometric close up view of Figure 7, showing details of the radome and reflector interlock.

DETAILED DESCRIPTION

[0020] Signals reflected from a radome surface that is tangential to the desired signal direction would be straight back into the signal path, contributing to the return loss of the reflector antenna. Also, reflections proximate the feed assembly encounter multiple surfaces from which to launch reflections that may finally be directed back to the feed, further contributing to return loss. A radome with a small radius reflects signals out of the signal path but also degrades the far field radiation pattern. Further, radomes with small radius configurations have an extended dimension along the signal axis of the reflector antenna, increasing the wind load and associated mechanical strength requirements for the reflector antenna and antenna support structure. The present invention utilizes a very large radius in an outer portion and a smaller radius for a central portion that is significantly larger (has a focal point at the reflector vertex area rather than the back side of the antenna feed) than central areas of two section radomes in the prior art. The radome configuration ac-

cording to the invention provides return loss, signal pattern improvements and a reduction in wind load.

[0021] For purposes of illustration, a first embodiment of the invention is shown in figures 1a and b. The radome 1 is dimensioned for use with a desired reflector antenna configuration, for example a deep dish reflector antenna with a self supported feed assembly as shown in figure 2. The radome 1 may be, for example, injection molded from a dielectric plastic such as ASA (acrylonnitrile styrene acrylate), polycarbonate or other materials with suitable strength, dielectric properties and UV stability. The radome 1 has a central portion 5 and an outer portion 10. The central portion 5 having a smaller radius than the outer portion 10. Specific radius configurations may be selected according to the desired reflector antenna the radome 1 is intended for.

[0022] As shown by Figure 3, the different radii of the central and outer portions 5,10 creates a reflection pattern that varies depending upon the radome 1 surface that incident RF 12 reflects from. The selected central portion 5 radius will depend upon the particular focal length and diameter of the desired reflector. The central portion 5 radius is configured so that an inner reflected component 13 of RF sig-

nals incident upon the central portion 5 is focused upon the reflector 14 vertex area 16. The vertex area 16, shaded by the antenna feed assembly 17, is not a reflector 14 surface used to project the RF signal into the desired radiation pattern. RF absorbing material 18 placed at the vertex area 16 may be used to absorb the portion of the reflected component 13 that is reflected by the radome 1 central portion 5 thereby preventing further reflections from the vertex area 16 that may be aligned with the antenna feed which would otherwise contribute to the return loss of the reflector antenna, overall.

[0023] The large radius of the outer portion 10 is selected to create outer reflected component(s) 20 that are not aligned with the feed path and therefore are not significant contributors to return loss of the antenna. Also, the large radius of the outer portion 10 introduces only minimal far field signal pattern degradation. For example, the outer portion 10 radius may be 1-2 meters for a one foot reflector antenna and 2-3 meters for a 2 foot reflector antenna.

[0024] The transition between the central portion 5 and the outer portion 10 is configured to occur at the point closest to the center of the radome 1 which does not create outer

reflected component(s) 20 that reflect from the reflector 14 upon the feed assembly.

[0025] The radome 1 may be mounted to the reflector 14 by any manner of interconnection, for example screws, clips, springs and or brackets.

[0026] As shown by figure 4, the periphery of the radome 1 may have integrated structure for tool-less interconnection between the radome 1 and the reflector 14. A plurality of support posts 22 may be used to create a mounting plane for the radome 1. A plurality of tabs 24 cooperating with a corresponding plurality of cut outs 26 formed in the periphery of the reflector 14 operate to retain the radome 1. When the tabs 24 and cut outs 26 are aligned with each other, as shown in figure 5, the radome 1 can be placed upon the reflector 14, the tabs 24 passing through the cut outs 26, until the radome 1 support posts 22 bottom upon the periphery of the reflector 14, as shown in figure 6. The radome 1 may then be rotated about the face of the reflector 14, separating the tabs 24 from the cut outs 26, thereby retaining the radome 1 against the reflector 14 periphery. Locking clips 30, momentarily compressed by the reflector 14 periphery snap out into the reflector 14 cut-outs 26 as the radome 1 is rotated. When snapped

into place, within the cut outs 26, the locking clips 30 prevent further rotation of the radome 1 with respect to the reflector 14, forming a secure connection between the radome 1 and the reflector 14, as shown in figures 7 and 8.

[0027] The radome 1 is secured by the interference between the tabs 24 and the periphery of the reflector 14 without cut outs 26 and the locking clips 30 within the cut outs 26, but otherwise floats in place. Therefore, there is no need for a mechanical fastener such as a rigid screw connection between the two components. Because both the radome 1 and the reflector 14 are free to expand or contract separately, according to the expansion coefficient of each, the chance of unequal expansion between the two causing a deformation of the radome 1 and or reflector 14 is reduced.

[0028] The signal pattern of the reflector antenna may be improved by adding a shroud lined with RF absorbing material around the periphery of the reflector. However, prior shrouds created a significant increase in the wind load of the resulting reflector antenna. Deep dish reflector configurations decrease the need for a full shroud. To obtain the partial benefit of a full shroud with a deep dish reflec-

tor 14, without increasing the windload of the antenna, RF absorbing material 18 may be added at the periphery of the reflector, under the radome 1. Absorber retainers 32 may be formed in the periphery of the radome 1 as mounting structure for retaining strip(s) or a ring of RF absorbing material 18.

[0029] The present invention brings to the art a radome with an improved RF signal pattern, return loss, wind loading and snow/ice buildup characteristics. Further the radome has a secure radome to reflector antenna mounting that allows relative expansion of the different components and does not require tools or multiple extra components that may create a drop hazard, be easily misplaced and or lost.

Table of Parts

1	radome
5	central portion
10	outer portion
12	incident RF
13	reflected component
14	reflector
16	vertex area
17	feed assembly
18	RF absorbing material
20	outer reflected component

22	support post
24	tab
26	cut out
30	locking clip
32	absorbing retainer

[0030] Where in the foregoing description reference has been made to ratios, integers, components or modules having known equivalents then such equivalents are herein incorporated as if individually set forth.

[0031] While the present invention has been illustrated by the description of the embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details, representative apparatus, methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departure from the spirit or scope of applicant's general inventive concept. Further, it is to be appreciated that improvements and/or modifications may be made thereto without departing

from the scope or spirit of the present invention as defined by the following claims.